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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.: —E 04 c 3/04

COMPLETE SPECIFICATION

Improvements in or relating to Structures

I, WILLIAM EDWARD LAWMAN, of 76 Southwood Gardens, Kenton, Newcastle-upon-Tyne 3, a British Subject, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to structures for assembly to form racks, particularly racks or supports for electric cables or pipes. The elements which the invention provides are adapted to be assembled in a number of ways, and can be secured to walls or be self-supporting so as to provide stable support for relatively heavy elongated articles.

The invention provides a structure comprising a first element serving as a post, of hollow, substantially rectangular cross-section having in one opposed pair of its walls a number of equally spaced, substantially rectangular apertures, the apertures in said pair of walls being of the same size and in register, two longitudinal sides of each aperture being parallel to the length of the element, and having a number of registering pairs of bolt holes in the other opposed pair of walls, said bolt holes being located in the transverse median planes of successive apertures in said one pair of walls; a second element, of hollow substantially rectangular cross-section and of such dimensions that said second element fits through a registering pair of apertures in the first element and is supported by engagement with the transverse sides of said apertures, and having registering pairs of bolt holes in its pair of walls that are fitted to said two longitudinal sides of said apertures in the first element; and bolt means which extend through a pair of bolt holes in said second element and at least one bolt hole in said first element holding the two elements together with the second element extending horizontally through the first element.

Structures according to the invention will be described in more detail by way of examples with reference to the accompanying drawings in which:—

Figure 1 shows structural post and beam elements and illustrates how these may be assembled together,

Figure 2 shows a further form of structural post element and also illlustrates a method of fixing a beam element to it,

Figure 3 shows a mode of attachment for the end of a beam element to a post element,

Figure 4 is a section on the line IV—IV of the attachment shown in Figure 3, and of an end of a beam element secured thereto,

Figure 5 shows a mode of attachment alternative to that shown in Figures 3 and 4, in perspective, and

Figure 6 is a perspective view of a member for use with the elements.

In Figure 1 the element shown generally as 1 is designed for use as a post. The element is of square hollow section having sides 2 and 3 opposite to each other and sides 4 and 5 opposite to each other. In each one of the four sides there are formed a series of rectangular apertures 6 and a series of bolt holes 7. The apertures and bolt holes alternate along the length of the element and the centre of each bolt hole lies on the longitudinal median plane of two adjacent apertures in the same wall. The apertures are all of the same size and these and the bolt holes in opposite walls are in register with each other. The centre of each bolt hole in each wall lies on the transverse median plane of a registering pair of rectangular apertures of the adjacent walls. Thus the bolt hole 8 in the wall 2 lies on the transverse median plane of the rectangular apertures 6 in the wall 4, and the bolt hole 7 in the wall 4 lies on the

transverse median plane of the rectangular aperture 9 in the wall 2. Although the apertures 6, 9, are shown in the figure as being exactly rectangular, in practice it is desirable that the corners be rounded off to make the apertures substantially rectangular.

As shown in Figure 1 the post 1 may be free standing, supported on the floor by a base plate 10 having a projecting square boss 11 of such dimensions that it fits closely within the square element 1. If the boss 11 is a push fit within the element 1 then no further fixing means are necessary, but if not then the boss can be designed to receive a fixing bolt passing through the bolt hole 12 and the hole in register with this in the opposite wall.

The posts may be manufactured to standard lengths, but the height of an assembly using the posts can be varied by joining a number of posts together using connecting elements such as the element 13. This element is in the form of a sleeve which again is a close fit within the square element 1 and is formed with bolt holes such as 14 for registering with bolt holes in the walls of the element 1 and an adjoining element so that the two elements are firmly held together.

Figure 1 also illustrates a second structural element 15 of rectangular cross-section, to serve as a beam. In this case the opposite walls 16 and 17 are wider than the opposite walls 18 and 19. The walls 16 and 17 are formed with alternate substantially rectangular apertures 20 and bolt holes in the form of elongated slots 21. The centre line of each slot 21 lies on the longitudinal median plane of two adjacent rectangular apertures. The apertures and slots in the opposite walls 16 and 17 are again in register with each other. The walls 18 and 19 are formed with bolt holes in the form of slots 22 only, and have not rectangular apertures. The external dimensions of the element 15 are such that it may be passed through registering rectangular apertures 6 in opposite walls of the first element 1 as shown in the figure. The two elements 1 and 15 are then held together by a bolt 23 and nut 24 passing through reducing washers 25 and 26 and through aligned bolt holes 8 and 21 in the elements 1 and 15 respectively. The dimensions of the rectangular apertures in the member 15 are the same as those in the member 1 so that a second length of the member 15 can be passed through apertures in a first length of this member.

The diameter of the bolt holes 8 in the element 1 is greater than the size of the head of the bolt 23, which is in turn larger than the width of the slot-form bolt holes 21 in the element 15. If, therefore, the reducing washer 25 is omitted, the head of the bolt will be able to be located against the wall 16 of the element 15 and within the bolt hole 8, so that the wall 2 of the element 1 will have no protrusion.

A third type of structural beam element is shown at 27 in Figure 1. It will be seen that this is again of rectangular section and of the same dimensions as the element 15. In the element 27 the wall 28 and its opposite wall are formed with rectangular apertures 29 only, and the wall 30 and the opposite wall are formed with bolt holes 31 only. The bolt holes 31 have their centre lines lying on the transverse median planes of the apertures 29. The apertures 29 are of the same dimensions as the apertures 20 in the element 15 and the apertures 6 in the element 1.

Two lengths of the element 15 can be joined together end to end, or a length of the element 15 can be joined end to end with a length of the element 27 as shown in Figure 1 by a connecting piece 32 having such external dimensions that it is a push fit within the elements to be joined. The connecting piece 32 may again be formed with bolt holes for registering with bolt holes in the elements to be joined to make a fixed connection.

Figure 2 shows a supplementary type of post element 42. Again the element is of rectangular cross-section having opposite walls 43 and 44 and opposite walls 45 and 46. Rectangular apertures 47 and bolt holes 48 are formed alternately only in the wall 43 and the centre of each bolt hole lies on the longitudinal median plane of two adjacent apertures. The wall 44 opposite to the wall 43 has spot welded to it sections of bent mild steel strip 49. The walls 45 and 46 both have a central longitudinal groove 50 for strengthening purposes. The element 42 is designed for use during building construction when it is positioned behind concrete shuttering and held by nails or wires to the back of the shuttering in a temporary manner until concrete has been poured. After removal of the shuttering the wall 43 of the element is the only wall showing and the mild steel sections 49 act as firm anchors for the member within the concrete. When the concrete is poured care must be taken that it is not allowed to enter into the section of the element, and to this end plastic caps 51, 52 and 53 are provided, which are respectively press fits within the end of the element 42, within the rectangular apertures 47, and within the bolt holes 48. After the concrete has been poured and the shuttering removed the caps 52 and 53 can be removed from the apertures in the bolt holes, although it will be seen that the cap 51 remains a fixture in the concrete.

Figure 2 also shows a method of attaching a structural element to the post element 42. In this case the structural element 54 to be attached is shown by way of example as a

cable tray support or support for cable or pipe cleats, but it will be appreciated that it may take any required form, and more particularly the form of either the element 15 of the element 27, which is supported at a distance from the element 42 by a post element as shown in Figure 1. The element 54 is welded at its end to the front surface of a plate 55, the rear surface of which carries two locating projections, a rectangular projection 56 and a circular projection 57. A bolt hole 58 is formed through the locating projection 56.

To fix the member 54 to the post element 42 a bolt 59 with a rectangular washer 60 which is welded to the bolt head is first inserted into a rectangular aperture 61. The washer 60 is of such dimensions that in one position it will pass through the aperture 61 but when rotated 45° from this position it will bear against the inner face of the wall 43 in which the aperture 61 is formed. After the washer has been turned to this position the plate 55 is then brought up to the wall 43, and the bolt is passed through bolt hole 58 in the plate. The locating projection 56 on the plate is fitted into the aperture 61, and the locating projection 57 on the plate is fitted into a bolt hole 62, in each case the locating projections being of such a size that they are a close fit within the aperture and bolt hole respectively. A reducing washer 63 is then passed over the end of the bolt 59, and a nut 64 is screwed along the bolt into tight engagement with the front face of the plate 55. This arrangement provides a firm cantilever support for the element 54.

Figure 3 again shows the post element 1 as described with reference to Figure 1, and shows how this may be attached to a wall 65 rather than used as a free standing element. The wall 65 has projecting therefrom a bolt 66 on which is optionally fitted a spacing boss 67. The bolt 66 passes through registering apertures, one of which is shown at 68, in opposite walls 69 and 70 of the element 1. A rectangular washer 71 with its corners relived is passed through the aperture 68 when in the position shown in solid lines in Figure 3, and is then rotated through 90° to the position shown in broken lines in this figure. The washer can thus bear against the inner face of the wall 70. A nut 72 is then screwed into the end of the bolt 66 by a box spanner inserted through the aperture 68 and it will be seen that the nut bearing on the washer which in turn bears on the inner face of the wall 70 holds the element 1 in position, spaced from the wall 65 by the spacing boss 67.

Figures 3 and 4 show yet another alternative method of supporting a member 73 on the post 1 in cantilever fashion. Again the member may be of any form, particularly the form of members 15 or 27 as shown in Figure 1. The member is welded to a plate 74 in which two rectangular cuts are made, the cut out material being bent back from the plate as shown at 75 in Figure 4. The distance 76 between the rear face of the plate 74 and the front of the bent back part 75 is slightly greater than the thickness of the wall of the post member 1. Projecting from the front face of the plate 74 is a hollow circular boss 77, the inner surface of the outer part of which is threaded as shown at 78. A threaded plug 79 can be screwed into the boss 77, and the head carries a compression spring 80 which bears on a locking member 81 of circular cross-section projecting through a circular hole 82 in the plate 74. The locking member 81 has at its inner end an outwardly turned flange 83 which engages against the sides of the hole 82 to hold the member captive within the boss 77.

To fit the plate to the post member 1 the bent back parts 75 are aligned with two adjacent rectangular apertures 68 in a wall of the element and the plate 74 is pressed into contact with the wall of the element so moving the locking member 81 into the boss 77 against the action of the spring 80. When the plate 74 is flush against the wall of the element the bent back parts 75 are located within the element 1 so that a downward movement of the plate 74 causes the parts 75 to engage behind the inner face of the wall of the element below the apertures through which they have been passed. When the locking member 81 comes into axial alignment with the hole 69 in the element 1 between the two apertures 68 then the spring 80 acts to force the element 81 into that hole to lock the plate 74 in the required position. To remove the plate the head 79 is screwed outwardly along the boss 77 to withdraw the spring and thus withdraw the locking member 81 to which the end of the spring is fixed. When the locking member is withdrawn from the hole the plate 74 can be lifted to withdraw the parts 75 from the wall of the element 1.

It has already been stated that the diameter of the bolt holes 8 in the element 1 is greater than the size of the head of the bolt 23 so that the head of this bolt can rest within the bolt hole 8 when the reducing washer 25 is omitted. This feature allows the plate 74 to be secured to the element 1 as described in such a position that the locking member 81 can engage the same bolt hole 8 in which the head of a bolt 23 is received.

Figure 5 shows an alternative form of the part shown in Figure 4, and usable in the same way as that part. The part of Figure 5 comprises a plate 90 to one surface of which an element such as the element 91 may be welded. The other surface of the plate has welded to it, or moulded integrally with it, a projection 92 having a body 93 and a

downwardly extending part 94. Below the projection 92 is a locking stud 95 which is spring biased to the position shown.

In use, when the plate is to be secured to an element 96, the projection 92 is inserted through a rectangular aperture 97 in the element, the locking stud 95 being forced to a position flush with the surface of the plate 90 by pressing the plate against the element. The plate is then moved downwardly whereupon the part 94 will engage behind the wall of the element and the part 98 of the projection will rest in the edge 99 of the rectangular aperture. In this position the locking stud will engage the bolt hole 100 in the element, to lock the parts together.

The part as just described has the advantage over that shown in Figure 4 that only one rectangular aperture of the element is utilised rather than two, and the capacity of the element is thus doubled.

An element such as 15 (Figure 1) having such a cross-section that it can be passed through any of the rectangular apertures in the post elements may be formed with any required arrangement of bolt holes relative to its own rectangular apertures 20, said element 15 is of a form where the loading is not expected to be heavy and the cross-section can therefore be weakened by having slots 22 as bolt holes in its upper and lower walls. If heavier loads are to be supported then the element should have circular bolt holes such as 7 in the opposite walls 18 and 19 and the walls 16 and 17 should similarly have circular holes rather than the slots 21, while the apertures 20 may be omitted.

Elements with circular bolt holes in thte walls 18 and 19 can be used for supporting cable trays directly, but when cable cleats are to be used for securing the cable then elongated slots rather than circular bolt holes are necessary. The member 100 shown in Figure 6 forms an adapter allowing cable cleats to be secured to a modified beam element 113 with circular bolt holes 116 alternated with rectangular apertures in the wall 117 and the opposite wall of the element and equally spaced bolt holes in the other pair of walls.

The adapter member 100 takes the form of an inverted U-shaped member having a top wall 110 and two side walls 111 and 112, the dimensions being such that the adapter will fit over the element 113, which has the same cross-sectional dimensions as the aforesaid element 15. The top wall 110 is punched with a series of slots 114 arranged with a shorter distance between adjacent slots than is the case with any of the structural elements themselves. The lower edges of the side walls have semi-circular notches 115 of a diameter equal to the diameter of the bolt holes 116. The depth of the side walls 111 and 112 is such that, when the adapter is resting with its notches engaging bolts passed through the bolt holes 116 in the element 113, then a clearance 118 is left between the lower surface of the top wall 110 of the adapter and the surface 119 of the element.

To secure a cable saddle clip 120 to the adapter when in position on the element, two key bolts 121 and 122 are used, which have heads 123 of such dimensions that they can pass through the slots 114 in one angular position, but not when rotated 45° from this position. The heads of the bolts are passed through the required slots, and then turned through 45° to lock the heads in the space 118 between the adapter and the element, with the heads resting on the surface 119 of the element. A saddle clip 120 of any required form then has its bolt holes 124 passed over the bolts and is locked in position on the bolts by nuts 125.

The provision of the space 118 between the element and the adapter and the use of key bolts means that clips can be added to or removed from the assembly without disturbing any of the other clips or their associated cables.

Use of this adapter allows a full range of possible positions for the clips, due to the slots, and yet enables the clips to be supported by an element of very strong section.

It will be appreciated that all the parts that have been described are inter-usable with each other and it is a simple matter to decide what parts are necessary to build up any desired rack structure. It will also be obvious that a number of elements not shown and described specifically can also be designed, for example with different arrangements of bolt holes relative to the rectangular apertures.

The elements described are not of course limited to any particular dimensions. For heavy duty cable supports and other applications where high loading is expected the elements are preferably made from 10 gauge sheet steel. For lighter loads 14 gauge sheet is preferable. Convenient dimensions for the post element 1 when using 14 gauge sheet are that it may have overall dimensions of rather less than 2″×2″, with side walls which are flat over a width of at least 1½″ both internally and externally and are joined by slightly rounded portions rather than meeting in the exact right angle shown in the drawings. The series of alternate rectangular apertures and bolt holes are symmetrical about the longitudinal mean plane, and are also symmetrical about transverse planes at a unit longitudinal spacing of 2½″. The rectangular apertures are 1″ wide in the transverse direction by 1½″ long, and the bolt holes are of a size suitable for the passage therethrough of the head of a selected standard bolt, for example a ⅜″ bolt.

The elements 15, 27 and 113 have external

dimensions allowing them to be passed through the rectangular 1"×1½" wide aperture in the element 1. The wider flat walls 16 and 17 of the element 15 have the apertures 20 again of a size 1" wide by 1½" long, while the slots 21 again provide clearance for the shank but not the head of a ⅜" bolt, but are 1½" in length. The slots 22 in the walls 18 and 19 of the elements 15 are of the same size as the slots 21, and in addition the spacing between the slots 22 is again 1½". This arrangement of slot means that the element 15 can be adjusted to any required length from the post element by varying the position of the bolt in the slot. In a particular example where the elements 15 are used as beams between two posts at the side of, say a tunnel, the elongated holes in the section 15 allow adjustment of 3" due to the fact that the elongated hole at each end is 1½" in length thus giving this adjustment at either end. To adjust by more than this 3" the next slot along the member is used, and the fact that the nearest ends of the slots are 1½" apart means that the members 15 may be adjusted to any desired width. When using 14 gauge sheet the dimensions of the elements can be suitably scaled down.

Structural elements according to the invention are adapted to form a variety of racks affording a multiplicity of anchorages for pipe or cable clips, hangers or other supports of various forms designed to secure pipes or cable singly or in groups, or perforated tray plating which is often employed, in various widths, for supporting numbers of electric cables.

WHAT I CLAIM IS:—

1. A structure comprising a first element serving as a post, of hollow, substantially rectangular cross-section having in one opposed pair of its walls a number of equally spaced, substantially rectangular apertures, the apertures in said pair of walls being of the same size and in register, two longitudinal sides of each aperture being parallel to the length of the element, and having a number of registering pairs of bolt holes in the other opposed pair of walls, said bolt holes being located in the transverse median planes of successive apertures in said one pair of walls; a second element, of hollow substantially rectangular cross-section and of such dimensions that said second element fits through a registering pair of apertures in the first element and is supported by engagement with the transverse sides of said apertures, and having registering pairs of bolt holes in its pair of walls that are fitted to said two longitudinal sides of said apertures in the first element; and bolt means which extend through a pair of bolt holes in said second element and at least one bolt hole in said first element holding the two elements together with the second element extending horizontally through the first element.

2. A structure according to claim 1, wherein said first element is of substantially square hollow section, each two opposed pairs of its walls having series of rectangular apertures, upper and lower sides of each aperture being perpendicular to the length of the element, and bolt holes alternate with said apertures, the apertures in opposite walls being of the same size and in register, the bolt holes in opposite walls being in register, and the bolt holes in each pair of walls being located on the transverse median planes of the rectangular apertures in the other pair of walls.

3. A structure according to claim 1 or 2, wherein said first element has bolt holes of a size to permit the passage of a head of a bolt and said second element has bolt holes of a size to permit the passage of a shank and prevent the passage of said head of the same bolt.

4. A structure according to claim 3, wherein said bolt means which hold the two elements together comprise two reducing washers located upon said bolt, each in one of a registering pair of bolt holes in said first element, with a head of said bolt and a nut member respectively engaging tightly each upon one of said washers.

5. A structure according to claim 3, wherein said bolt means which hold the two elements together comprise a bolt with its head bearing against one wall of said second element and thereby housed within said first element, a reducing washer located upon said bolt in one of the bolt holes of said first element and bearing upon one wall of said first element, and nut means engaging said bolt and tightened upon said reducing washer.

6. A structure according to claim 1 or 2, further comprising a third element intended to serve as another post, of hollow substantially rectangular cross-section, having in at least one of its walls a number of equally spaced, substantially rectangular apertures, two sides of each aperture being parallel to the length of the third element; and said second element having fixed to one of its ends, remote from said first element, a plate, the plate bearing, on the side facing away from the second element, locating means for cooperating with at least one aperture in said third element, and having means whereby said second element is securable to the third element to hold the second element in a required position relative to the third element.

7. A structure according to claim 6, wherein said third element has a number of bolt holes alternate with and equally spaced between said apertures; and said second element has a plate fixed to one of its ends, remote from said first element, the plate bearing on the side facing away from the second ele-

ment, locating means for co-operating with at least one aperture in said third element, and said plate further having means to co-operate with a bolt hole adjacent said one aperture in the third element, for the securing of said plate and therewith the end of the second element to said third element.

8. A structure according to any of the preceding claims, wherein the bolt holes in said second element are alternated with rectangular apertures in the same pair of walls, which apertures are of the same dimensions as the apertures in the first element.

9. A structure according to any of the preceding claims, wherein the bolt holes in said second element are elongated slots.

10. A structure substantially as hereinbefore described with reference to Fig. 1, or Figs. 1 and 2, or Figs. 1, 3 and 4 of the accompanying drawings.

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1093282 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

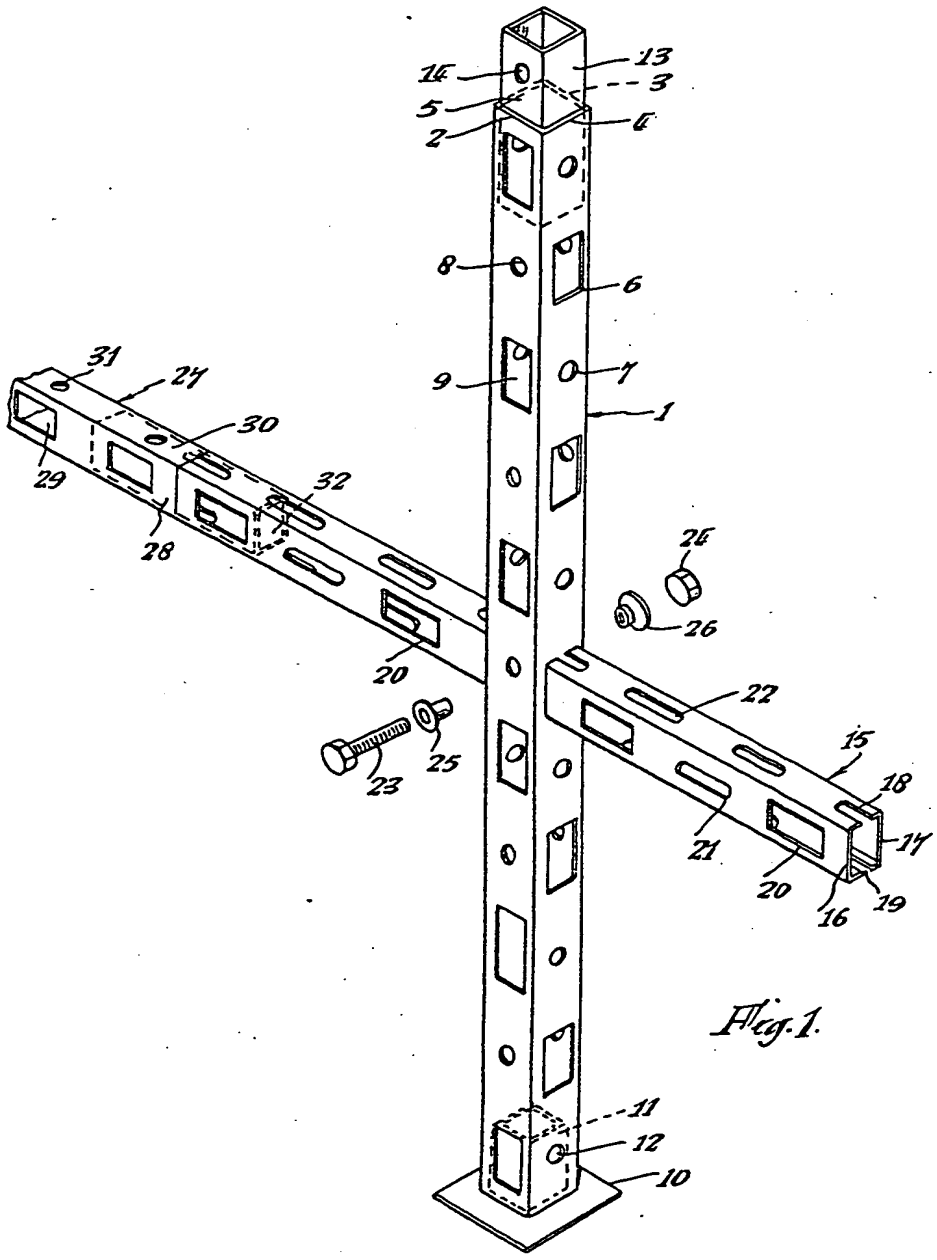

Fig. 1.

1093282 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 2 & 3

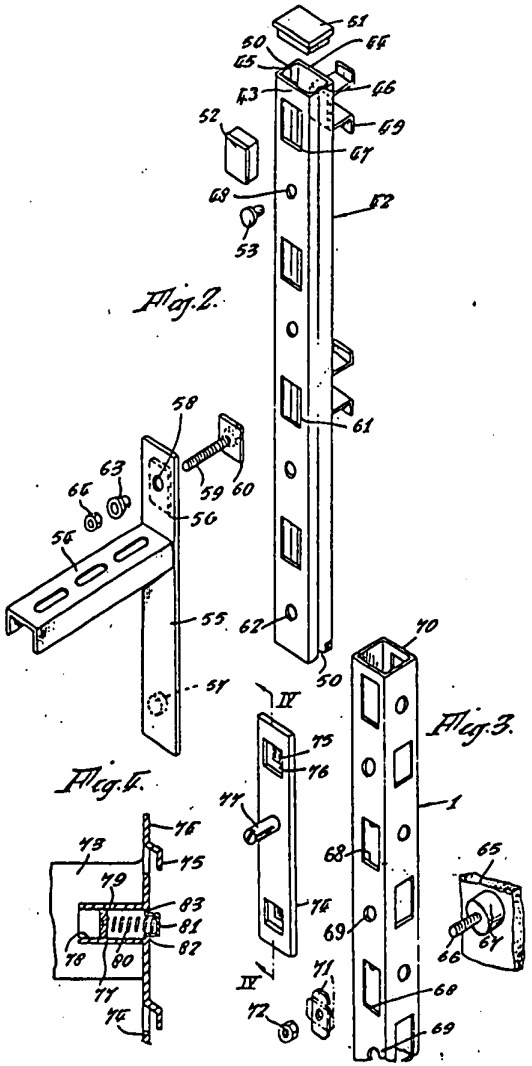

Fig. 2.

Fig. 3.

Fig. 4.

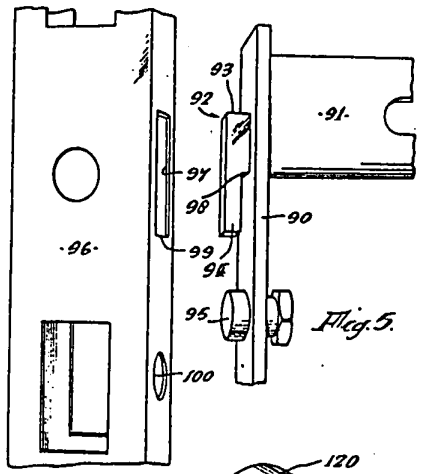

Fig. 5.

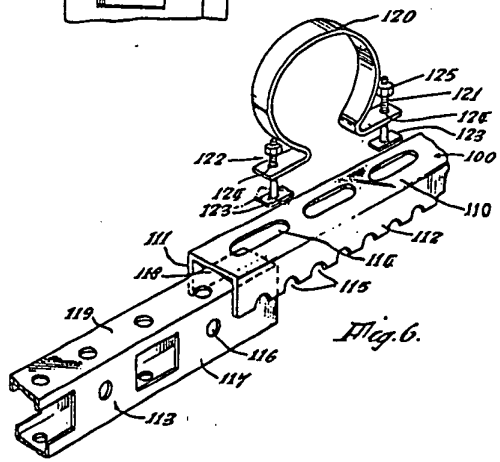

Fig. 6.